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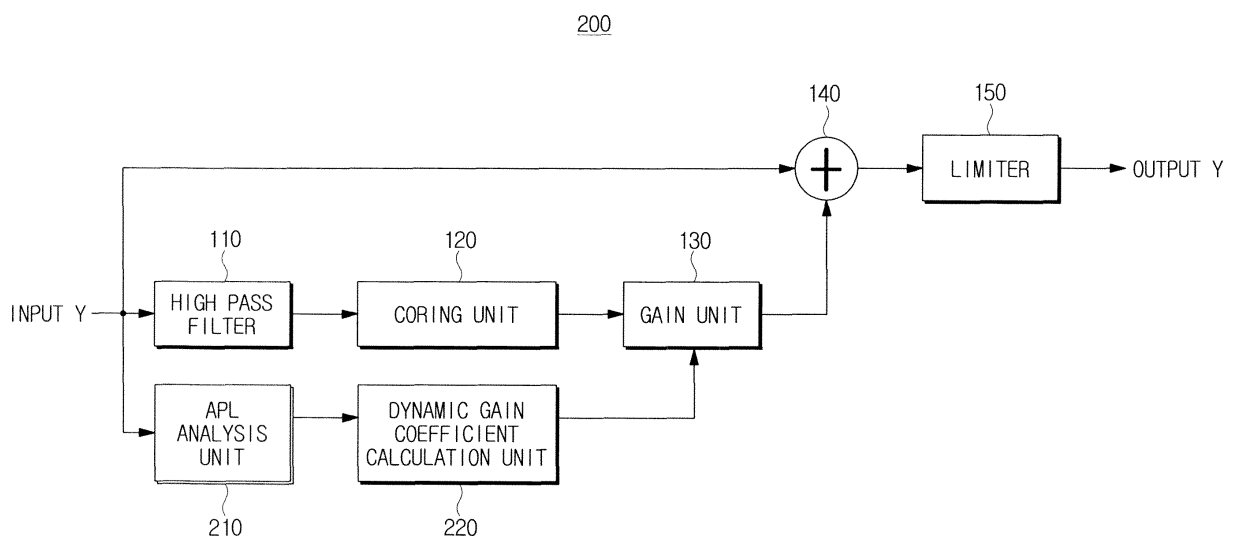
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(54) **Dynamic gain adjustment method based on brightness and apparatus thereof**

(57) A dynamic gain adjustment method and apparatus based on brightness are provided. The dynamic gain adjustment method and apparatus amplify or attenuate high frequency components of an input video signal by dynamically varying a gain that is applied to a peaking algorithm block for picture quality improvement in a video

processing device, such as a digital television, based on an average picture level (APL) of the input video signal. The gain can be dynamically adjusted when the APL of the input video signal is high or low, and thus saturation of the video signal during the operation of the peaking block can be prevented.

FIG. 2



Description

[0001] Apparatuses and methods consistent with the present invention relate to dynamic gain adjustment based on brightness.

[0002] A peaking algorithm block has been used in a video processing devices for the purpose of picture quality improvement.

[0003] Figure 1 is a block diagram illustrating the construction of a related art peaking algorithm block.

[0004] The related art peaking algorithm block includes a high pass filter (HPF) 11, a coring unit 12, a gain unit 13, a mixer 14, and a limiter 15.

[0005] Based on this related art peaking algorithm block, the high pass filter 11 separates high frequency components from an input signal, and the coring unit 12 removes noise components from the high frequency components. The gain unit 13 then amplifies or attenuates the high frequency components applied from the coring unit 12, and the mixer 14 mixes the amplified or attenuated high frequency components with the input signal. The limiter 15 limits a peaked part of the mixed signal.

[0006] The related art peaking algorithm block has been used to improve the luminance frequency characteristic of an input video signal. High frequency components are extracted from the original signal through the high pass filter 11, the extracted high frequency components are amplified or attenuated through the gain unit 13, and then the amplified or attenuated high frequency components are mixed with the original signal through the mixer 14.

[0007] However, since this related art peaking algorithm block operates only based on the frequency, irrespective of the brightness of a video signal, the same gain value is continuously applied to the signal, irrespective of whether the brightness of the video signal is high or low. This may cause unwanted results, such as saturation of the video signal.

[0008] Some exemplary embodiments of the present invention overcome some of the above disadvantages and problems described above. Some exemplary embodiments of the present invention may overcome other disadvantages and the problems not described above.

[0009] The present invention provides a dynamic gain adjustment method and apparatus based on brightness, which can dynamically vary a gain that is applied to a peaking algorithm block for picture quality improvement in a video processing device, such as a digital TV, based on an APL of a video signal.

[0010] The present invention relates to dynamic gain adjustment based on brightness which can amplify or attenuate high frequency components of an input video signal by dynamically varying a gain that is applied to a peaking algorithm block for picture quality improvement in a video processing device, such as a digital television (TV), based on an average picture level (APL) of the input video signal.

[0011] According to an aspect of the present invention,

there is provided a dynamic gain adjustment method based on brightness, which comprises calculating an APL value of an input video signal, calculating a dynamic gain coefficient based on the APL value, and amplifying or attenuating high frequency components separated from the input video signal by dynamically adjusting a gain value based on the dynamic gain coefficient.

[0012] The operation of calculating the APL value may comprise calculating the APL value of the input video signal in the unit of a frame.

[0013] The operation of calculating the dynamic gain coefficient may comprise calculating the dynamic gain coefficient such that the gain value decreases when the APL value is smaller than normal.

[0014] The operation of calculating the dynamic gain coefficient may comprise calculating the dynamic gain coefficient such that the gain value decreases when the APL value is larger than normal.

[0015] The operation of calculating the dynamic gain coefficient may comprise calculating the dynamic gain coefficient such that a preset gain value is used when the APL value is in a normal range.

[0016] According to another aspect of the present invention, there is provided a dynamic gain adjustment apparatus based on brightness, which comprises an APL analysis unit which calculates an APL value of an input video signal, a dynamic gain coefficient calculation unit which calculates a dynamic gain coefficient based on the APL value, and a gain unit which amplifies or attenuates high frequency components separated from the input video signal by dynamically adjusting a gain value based on the dynamic gain coefficient.

[0017] The APL analysis unit may calculate the APL value of the input video signal in the unit of a frame.

[0018] The dynamic gain coefficient calculation unit may calculate the dynamic gain coefficient such that the gain value decreases when the APL value is smaller than normal.

[0019] The dynamic gain coefficient calculation unit may calculate the dynamic gain coefficient such that the gain value decreases when the APL value is larger than normal.

[0020] The dynamic gain coefficient calculation unit may calculate the dynamic gain coefficient such that a preset gain value is used when the APL value is in a normal range.

[0021] For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings in which:

Figure 1 is a block diagram illustrating the construction of a related art peaking algorithm block;

Figure 2 is a block diagram illustrating the construction of a dynamic gain adjustment based on brightness according to an exemplary embodiment of the

present invention;

Figure 3 is a flowchart illustrating a dynamic gain adjustment method based on brightness according to an exemplary embodiment of the present invention; and

Figure 4 is a graph showing a relationship between an APL value and a gain according to an exemplary embodiment of the present invention.

[0022] Throughout the drawings, like reference numerals will be understood to refer to like parts, components, and structures.

[0023] The matters defined in the description, such as a detailed construction and elements, are provided to assist in a comprehensive understanding of embodiments of the invention, and are merely exemplary. Accordingly, those of ordinary skill in the art will recognize that various changes and modifications of the exemplary embodiments described herein can be made without departing from the scope of the invention. Also, descriptions of well-known functions and constructions are omitted for clarity and conciseness.

[0024] Figure 2 is a block diagram illustrating the construction of a dynamic gain adjustment based on brightness according to an exemplary embodiment of the present invention.

[0025] The dynamic gain adjustment apparatus 200 comprises an HPF 110, a coring unit 120, a gain unit 130, a mixer 140, a limiter 150, an APL analysis unit 210, and a dynamic gain coefficient calculation unit 220.

[0026] The HPF 110 separates high frequency components from an input video signal.

[0027] The coring unit 120 removes components which are less than a specified size from the high frequency components of the input video signal. The coring unit 120 is mainly used to remove noise.

[0028] The gain unit 130 amplifies or attenuates the high frequency components of the video signal applied from the coring unit 120.

[0029] The mixer 140 mixes the video signal, of which the high frequency components have been amplified or attenuated, with the input video signal.

[0030] The limiter 150 limits a peaked part of the mixed video signal.

[0031] The APL analysis unit 210 calculates an APL value of the input video signal in the unit of a frame. For example, if a frame is composed of 512 pixels, the APL analysis unit 210 calculates the APL value by summing up the picture values of the 512 pixels that constitute one frame, and then dividing the summed value by 512.

[0032] The dynamic gain coefficient calculation unit 220 calculates a gain coefficient having the characteristic as illustrated in Figure 4, in accordance with the APL value applied from the APL analysis unit 210, and transfers the calculated gain coefficient to the gain unit 130.

[0033] It can be seen from Figure 4 that the gain coef-

ficient calculated by the dynamic gain coefficient calculation unit 220 has a very small value if the picture is very dark because the APL value is smaller than normal, or the picture is very bright because the APL value is larger than normal. Also, as illustrated in Figure 4, if the picture has an APL value of 'a' and a gain of 'g', a preset gain coefficient is applied to the video signal without modification.

[0034] Figure 3 is a flowchart illustrating a dynamic gain adjustment method based on brightness according to an exemplary embodiment of the present invention.

[0035] The dynamic gain adjustment apparatus can be applied to a digital TV that processes and outputs an input video signal. The dynamic gain adjustment apparatus can also be applied to all video processing devices that have peaking algorithm blocks.

[0036] In addition, the dynamic gain adjustment apparatus can be applied to a peaking algorithm block used for picture quality improvement when a video signal input to the digital TV is processed through a video decoder, a deinterlacer, or a scaler.

[0037] First, a video signal is inputted to a receiving unit of the dynamic gain adjustment apparatus according to an exemplary embodiment of the present invention (S302).

[0038] The input video signal is also applied to the HPF 110 and the APL analysis unit 210.

[0039] The APL analysis unit 210 calculates the APL of the input video signal in the unit of a frame, and transfers the calculated APL to the dynamic gain coefficient calculation unit 220 (S304).

[0040] For example, if a frame is composed of 1024×680 pixels, the APL analysis unit 210 calculates the APL value by summing up picture values of the respective pixels, and then dividing the summed value by 1024×680 .

[0041] The dynamic gain coefficient calculation unit 220 calculates a dynamic gain coefficient having the characteristic as illustrated in Figure 4, based on the APL value transferred from the APL analysis unit 210 (S306).

[0042] With reference to Figure 4, the dynamic gain coefficient calculation unit 220 calculates a slope value ' α ', based on which a gain value 'g' is calculated by the gain unit 130. Here, the slope value corresponds to the dynamic gain coefficient.

[0043] Specifically, the dynamic gain coefficient calculation unit 220 calculates the dynamic gain coefficient such that the gain value decreases when the APL value is smaller than a general APL value 'a', as shown in Figure 4. In the same manner, the dynamic gain coefficient calculation unit 220 calculates the dynamic gain coefficient such that the gain value decreases when the APL value is larger than the general APL value 'a'.

[0044] Also, the dynamic gain coefficient calculation unit 220 calculates the dynamic gain coefficient such that a preset gain value 'g' is used when the APL value is within a range of normal APL values near 'a', as illustrated in Figure 4.

[0045] The dynamic gain coefficient calculation unit 220 then transfers the calculated dynamic gain coefficient to the gain unit 130 (S308).

[0046] The HPF 110 separates high frequency components from the input video signal, and the coring unit 120 removes components which are less than a specified size from the high frequency components of the input video signal. The gain unit 130 amplifies or attenuates the high frequency components of the video signal applied from the coring unit 120 in accordance with the dynamic gain coefficient applied from the dynamic gain coefficient calculation unit 220.

[0047] The gain unit 130 amplifies or attenuates the high frequency components by adjusting the gain in accordance with the characteristic of Figure 4, which is obtained through the dynamic gain coefficient applied from the dynamic gain coefficient calculation unit 220 (S310).

[0048] Accordingly, the dynamic gain adjustment apparatus can dynamically adjust the gain in both cases where the APL of the input video signal is high and low.

[0049] The dynamic gain adjustment apparatus 200, including the APL analysis unit 210 and the dynamic gain coefficient calculation unit 220, can be applied to the horizontal or vertical peaking of a video processing device provided with a peaking algorithm block. Also, the apparatus 200 can be applied to all integrated circuits (IC) using the peaking function in the video processing device, such as a TV.

[0050] Exemplary embodiments of the present invention can be written as codes, instructions, or programs, and can be implemented in general-use devices that execute the codes, instructions, or programs using a computer-readable recording medium. Examples of the computer-readable recording medium comprise magnetic storage media, such as ROM, floppy disks, and hard disks; optical recording media, such as CD-ROMs and DVDs; and storage media. The computer-readable recording medium can also be distributed over network coupled computer systems so that the computer-readable code is stored and executed in a distributed fashion. Also, functional programs, codes, and code segments for accomplishing exemplary embodiments of the present invention can be easily construed by programmers skilled in the art to which the present invention pertains.

[0051] As described above, according to the dynamic gain adjustment method and apparatus based on brightness, the high frequency components of an input video signal can be amplified or attenuated by dynamically varying the gain that is applied to the peaking algorithm block for picture quality improvement in a video processing device, such as a digital TV, based on the APL of the input video signal.

[0052] Accordingly, the gain can be dynamically adjusted when the APL of the input video signal is high or low, and saturation of the video signal during the operation of the peaking block can be prevented.

[0053] In addition, by applying the dynamic gain ad-

justment to all peaking blocks used for a picture quality improvement, a smooth peaking operation can be achieved through the gain adjustment based on the brightness.

[0054] The foregoing exemplary embodiments and advantages are merely exemplary and are not construed as limiting the present invention. The present teaching can be readily applied to other types of apparatuses. Also, the description of exemplary embodiments of the present invention is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art.

[0055] Although a few preferred embodiments have been shown and described, it will be appreciated by those skilled in the art that various changes and modifications might be made without departing from the scope of the invention, as defined in the appended claims.

[0056] Attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

[0057] All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

[0058] Each feature disclosed in this specification (including any accompanying claims, abstract and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0059] The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. A dynamic gain adjustment method based on brightness, the method comprising:

calculating an average picture level (APL) value of an input video signal;
calculating a dynamic gain coefficient based on the APL value; and
amplifying or attenuating high frequency components separated from the input video signal by dynamically adjusting a gain value based on

the dynamic gain coefficient.

2. The method of claim 1, wherein the calculating the APL value comprises calculating the APL value of the input video signal in a unit of a frame. 5
3. The method of claim 1 or 2, wherein the calculating the dynamic gain coefficient comprises calculating the dynamic gain coefficient such that the gain value decreases if the APL value is smaller than a specified APL value. 10
4. The method of claim 1, 2 or 3, wherein the calculating the dynamic gain coefficient comprises calculating the dynamic gain coefficient such that the gain value decreases if the APL value is larger than a specified APL value. 15
5. The method of any of claims 1 to 4, wherein the calculating the dynamic gain coefficient comprises calculating the dynamic gain coefficient such that a preset gain value is used if the APL value is within a specified range of APL values. 20
6. A dynamic gain adjustment apparatus (200) based on brightness, the apparatus comprising: 25
 - an average picture level (APL) analysis unit (210) which calculates an APL value of an input video signal; 30
 - a dynamic gain coefficient calculation unit (220) which calculates a dynamic gain coefficient based on the APL value; and
 - a gain unit (130) which amplifies or attenuates high frequency components separated from the input video signal by dynamically adjusting a gain value based on the dynamic gain coefficient. 35
7. The apparatus (200) of claim 6, wherein the APL analysis unit (210) calculates the APL value of the input video signal in a unit of a frame. 40
8. The apparatus (200) of claim 6 or 7, wherein the dynamic gain coefficient calculation unit (220) calculates the dynamic gain coefficient such that the gain value decreases if the APL value is smaller than a specified APL value. 45
9. The apparatus (200) of claim 6, 7 or 8, wherein the dynamic gain coefficient calculation unit (220) calculates the dynamic gain coefficient such that the gain value decreases if the APL value is larger than a specified APL value. 50
10. The apparatus (200) of any of claims 6 to 9, wherein the dynamic gain coefficient calculation unit (220) calculates the dynamic gain coefficient such that a 55

preset gain value is used if the APL value is within a specified range of APL values.

11. The apparatus (200) of any of claims 6 to 10, further comprising:

- a high pass filter (110) which separates high frequency components from the input video signal;
- a coring unit (120) which removes components which are less than a specified size from the high frequency components of the input video signal;
- a mixer (140) which mixes a video signal, of which the high frequency components have been amplified or attenuated, with the input video signal; and
- a limiter (150) which limits a peaked part of the mixed video signal.

FIG. 1

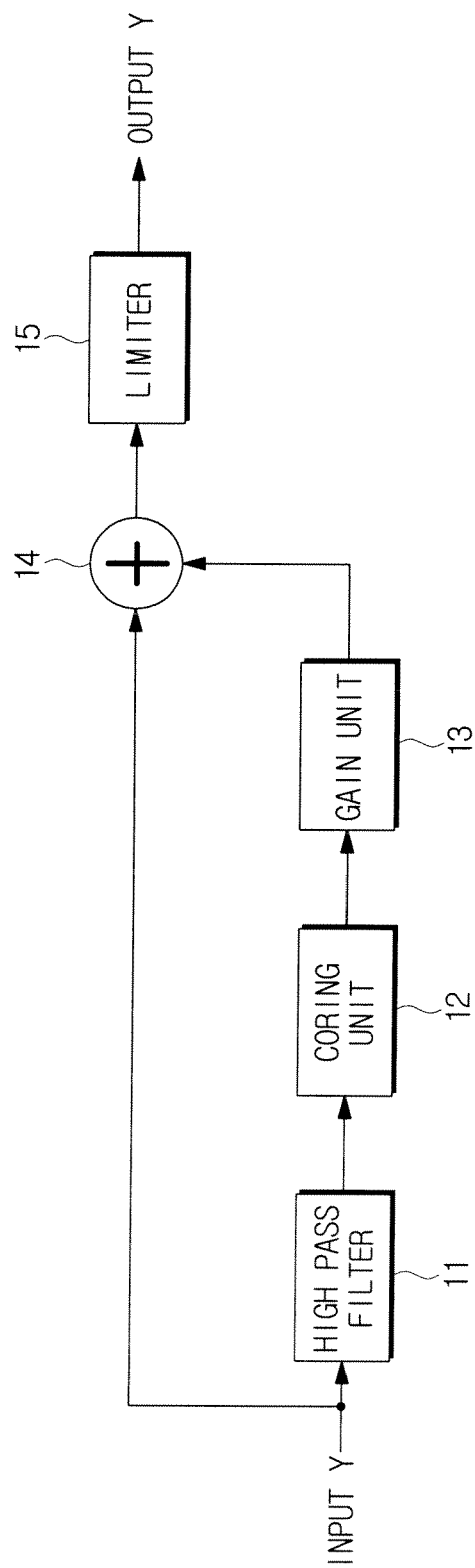


FIG. 2

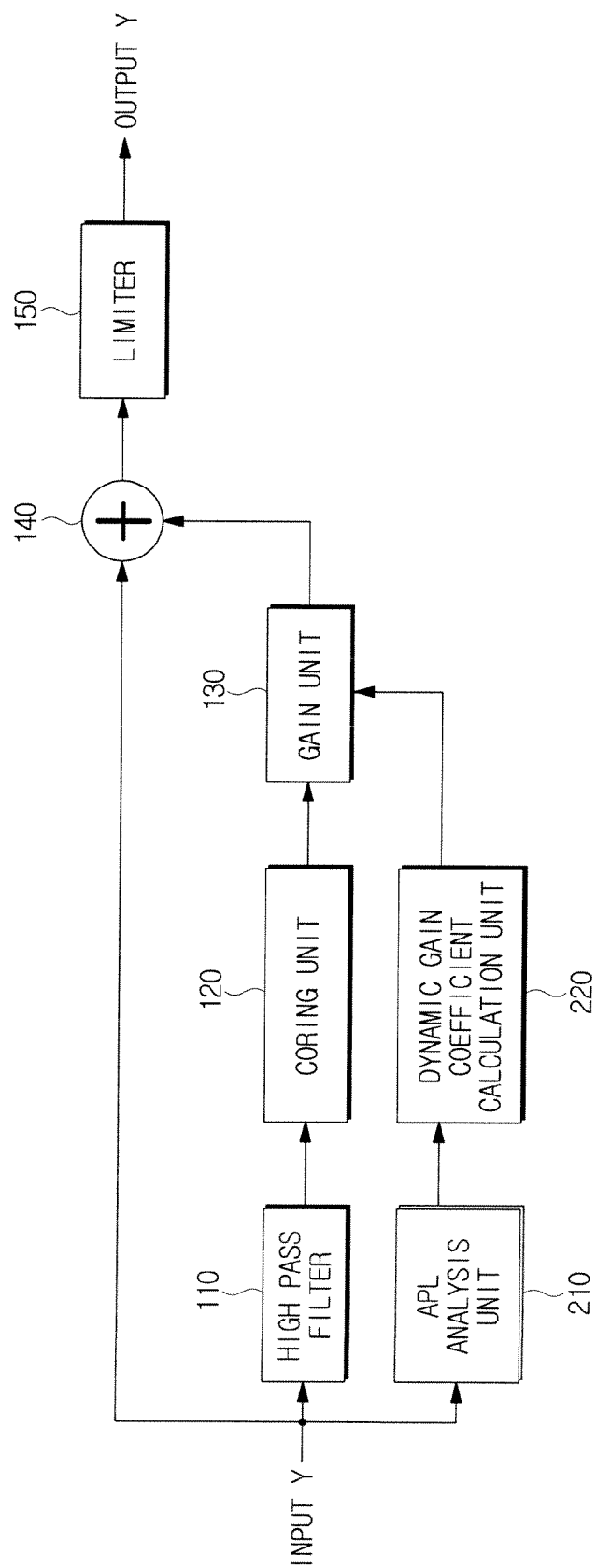
200

FIG. 3

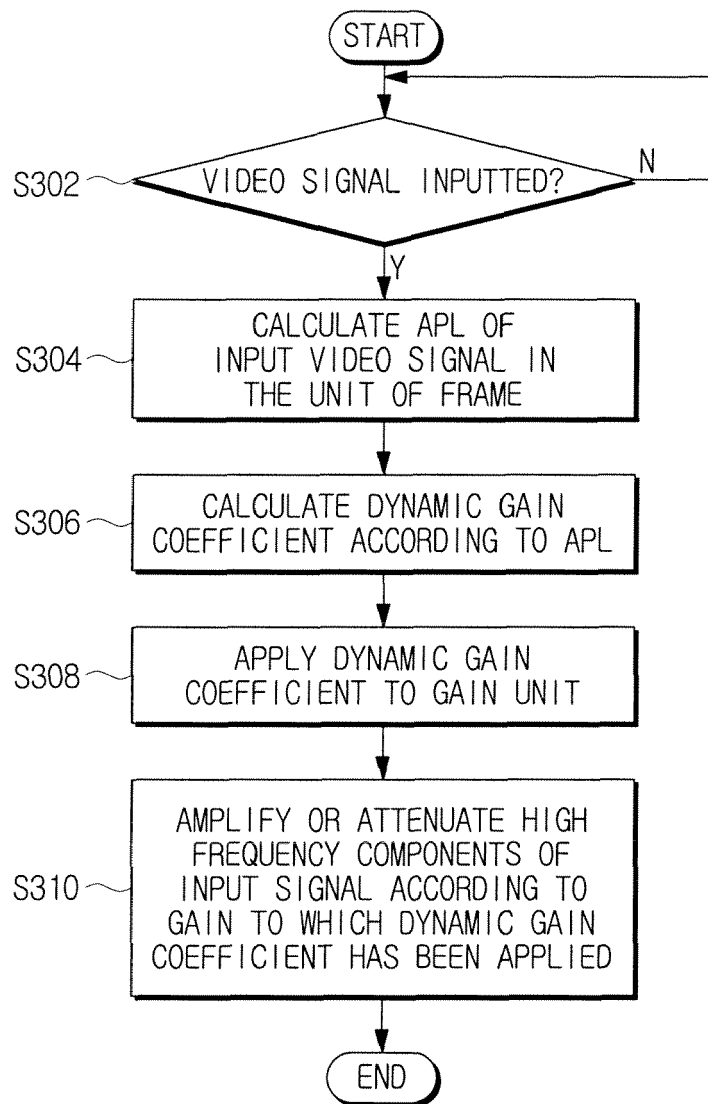
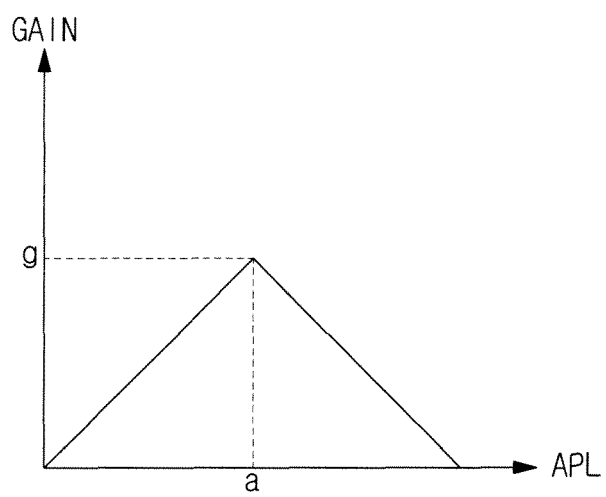


FIG. 4





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Application Number
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